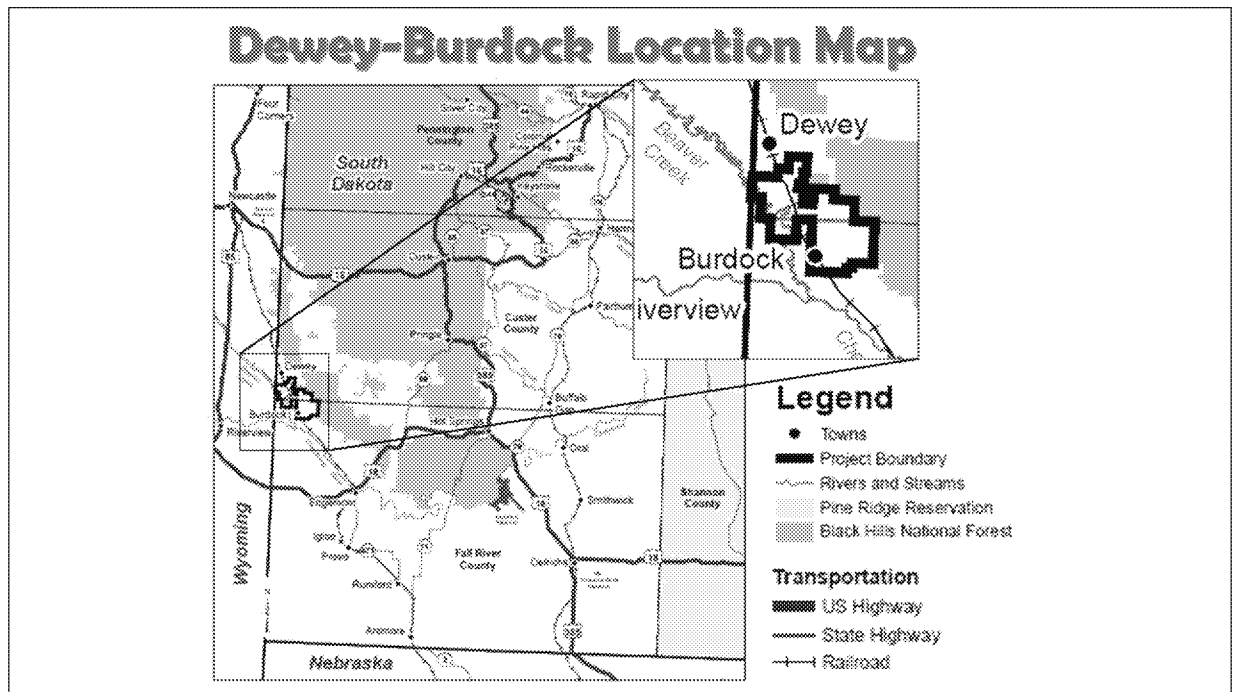


**U.S. Environmental Protection Agency
Underground Injection Control Program**

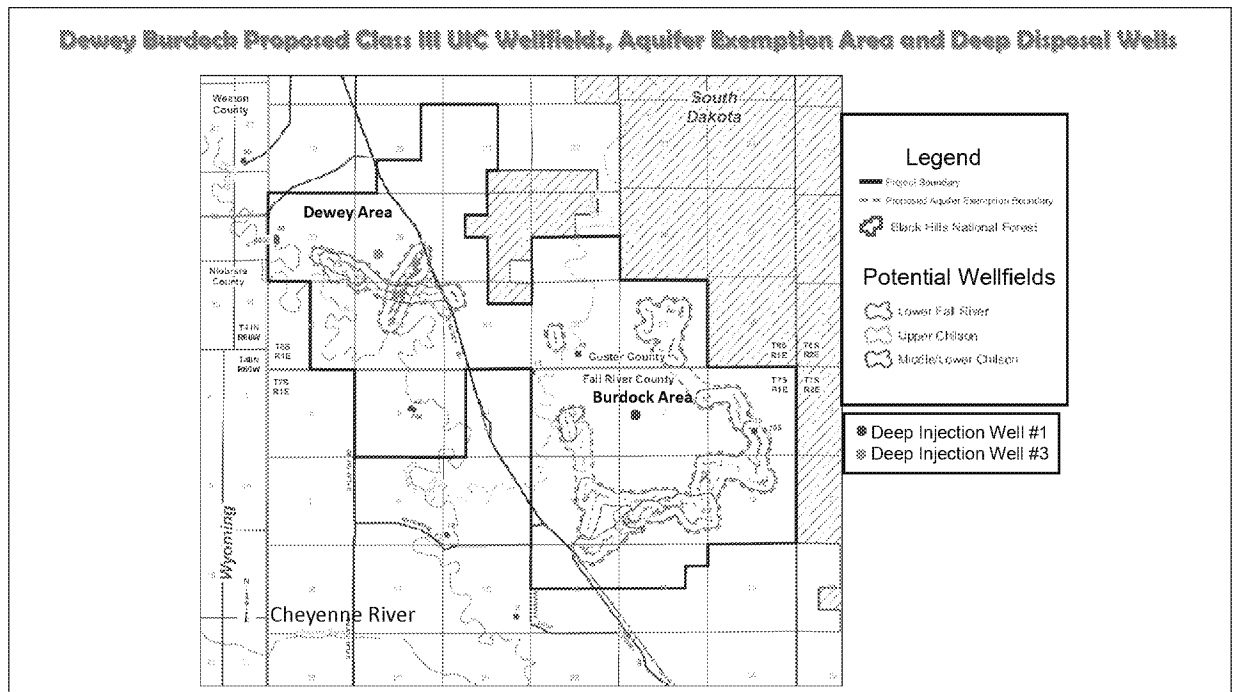
***Draft Class III and Class V Permits
and Proposed Aquifer Exemption at the
Dewey-Burdock In-Situ Uranium Recovery Site
near Edgemont, South Dakota***



The Dewey Burdock site is located in the SW corner of Custer County and the NW corner of Fall River County on the Wyoming/South Dakota border. In the southern Black Hills. About 45 miles west of the Pine Ridge Reservation. Very close to Cheyenne River which is a concern for Oglala Sioux and Cheyenne River Sioux Tribes since the Cheyenne River borders their reservations.

**The EPA Region 8 UIC Program Received
Permit Applications
for Two Types of Injection Wells**

1. A Class III Permit Application for the injection of lixiviant to mobilize uranium in the ore bodies and an associated aquifer exemption request for ore-bearing portions of Inyan Kara Group aquifers within the proposed wellfields.
2. A Class V Permit Application for the disposal of treated ISR waste fluids into deep injection wells.



AE Boundary 120 feet outside of wellfield monitoring ring.

Point out:

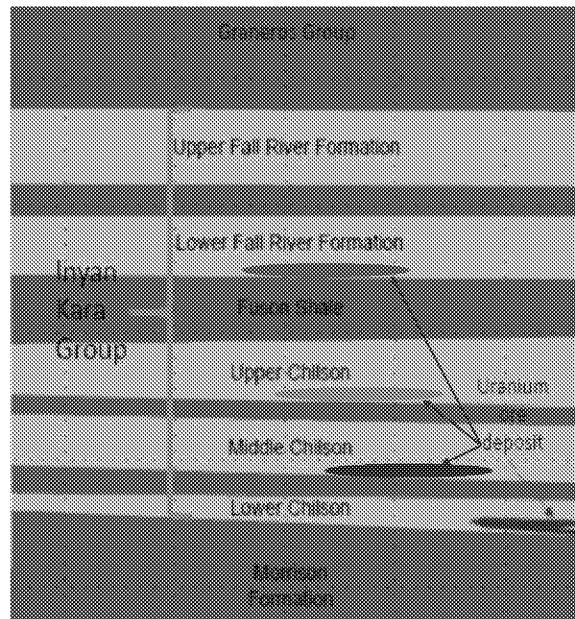
SD WY Border

Custer and Fall River Counties

Dewey Area & Burdock Area

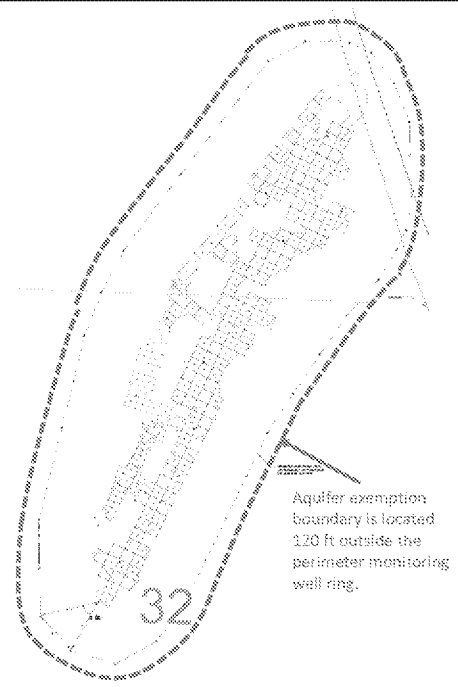
4 proposed wellfields in Dewey Area & 10 proposed wellfields in the Burdock Area.

Vertical Extent of the Aquifer Exemption Boundary

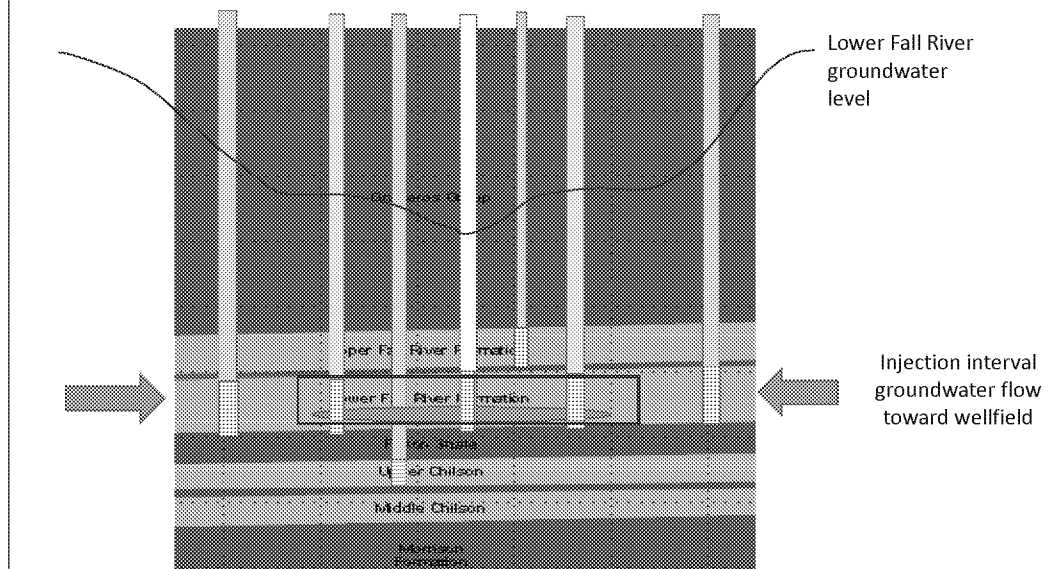


Typical AE Boundary Location for an ISR Wellfield at Dewey-Burdock

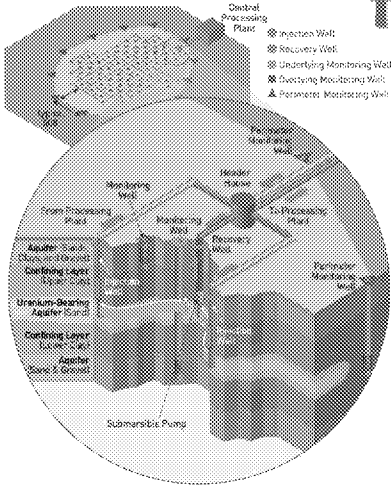
Aquifer Exemption Boundary



Horizontal Extent of Injected Fluids



The In Situ Uranium Recovery Process

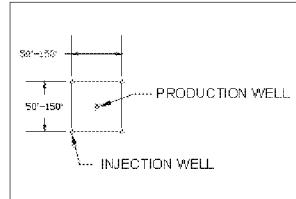


Injection wells pump a solution of native ground water, usually mixed with sodium bicarbonate and oxygen, into the aquifer (ground water) containing uranium ore. The solution dissolves the uranium from the deposit in the ground and is then pumped back to the surface through recovery wells. All contained by the header house. From there it is sent to the processing plant. Monitoring wells are checked regularly to ensure that hydrogen sulfide is not seeping from the wellhead. Confining layers keep ground water from moving from one aquifer to another.

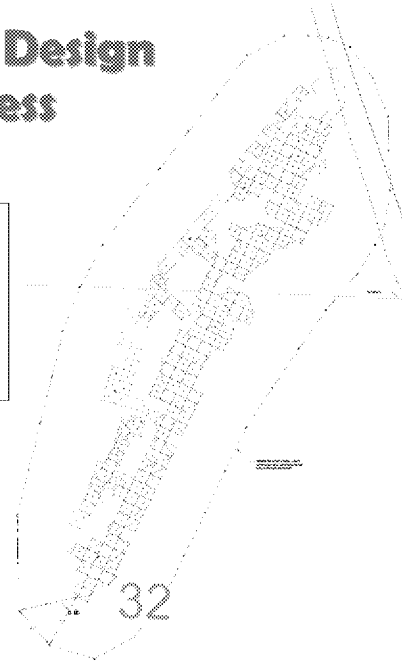
As of July 2005

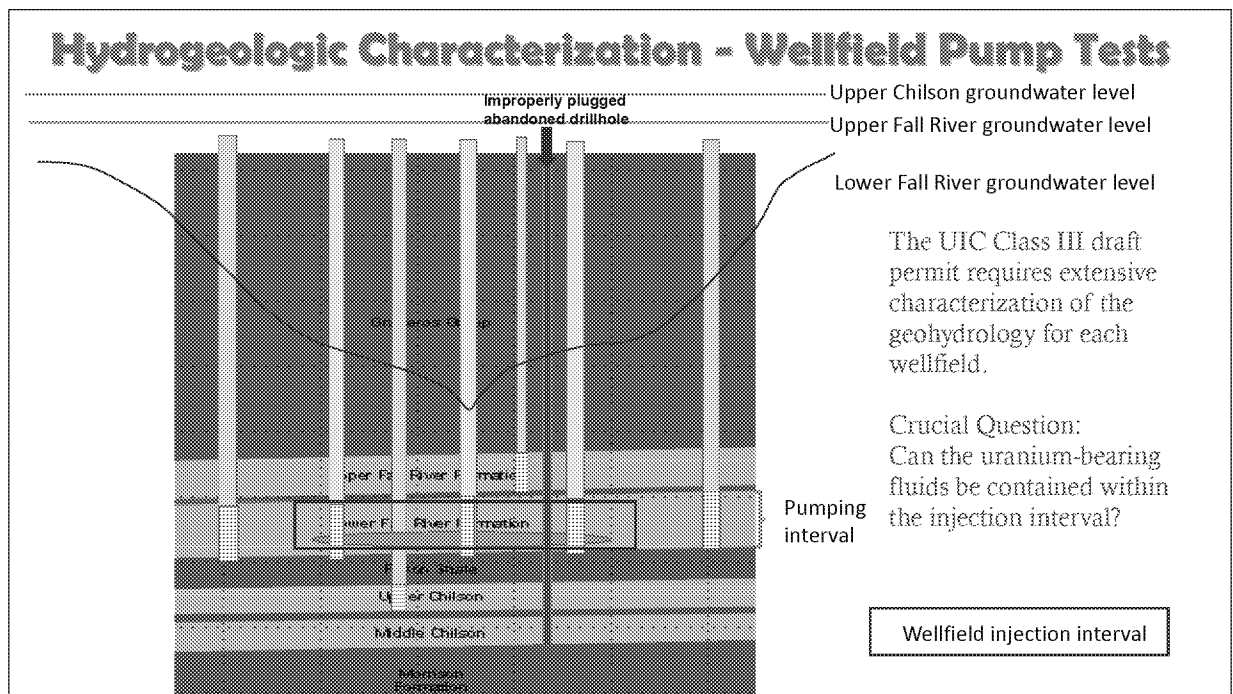
USNRC
U.S. Nuclear Regulatory Commission
Protecting People and the Environment

Typical Wellfield Design and ISR Process



- ⊗ PERIMETER MONITOR WELL
- ⊕ OVERLYING MONITOR WELL
- ⊙ UNDERLYING MONITOR WELL





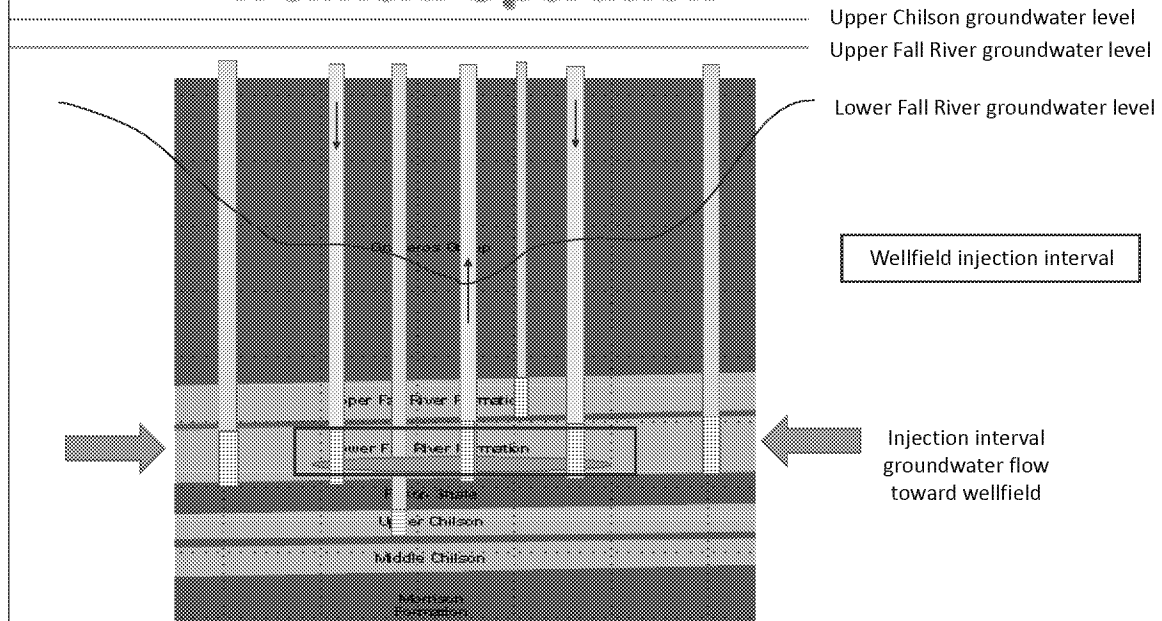
The data must demonstrate vertical confinement to prevent movement of fluids out of the injection zone so that no USDWs are contaminated.

The data must also demonstrate that it is possible to contain injection zone fluids horizontally to prevent contaminant migration into USDWs.

Important Draft Permit Requirements

- Excursion Monitoring
- Post-Restoration Monitoring

Wellfield Operation



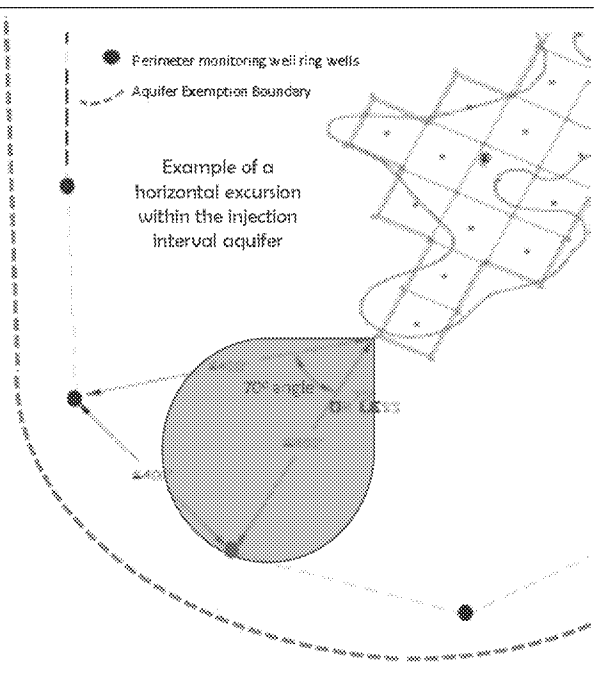
Excursion Monitoring

When components of the lixiviant move out of the wellfield injection interval area and are detected at the perimeter monitoring wells, the event is called an "excursion."

The excursion indicators would be chloride, specific conductance and alkalinity.

If an excursion is detected at a perimeter monitoring well, the monitoring frequency of the impacted well is increased to every week until the excursion plume is removed.

The Class III permit requires that the wells impacted by the excursion and the monitoring wells the nearest impacted monitoring wells are sampled every week.

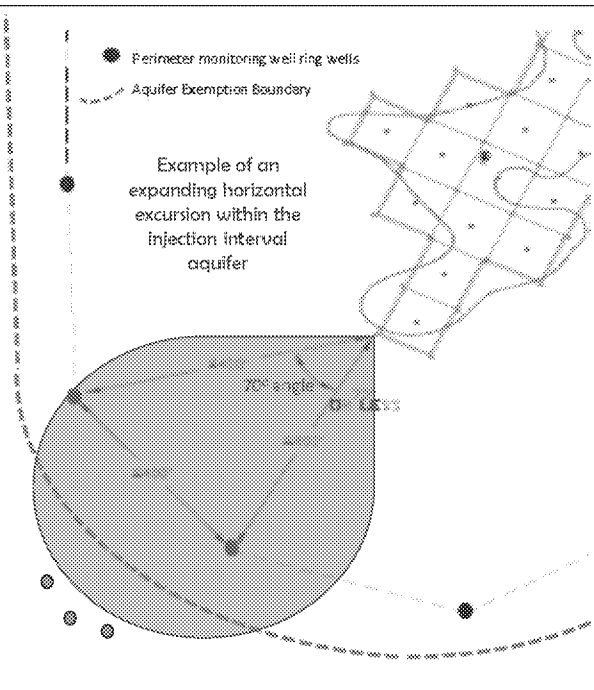


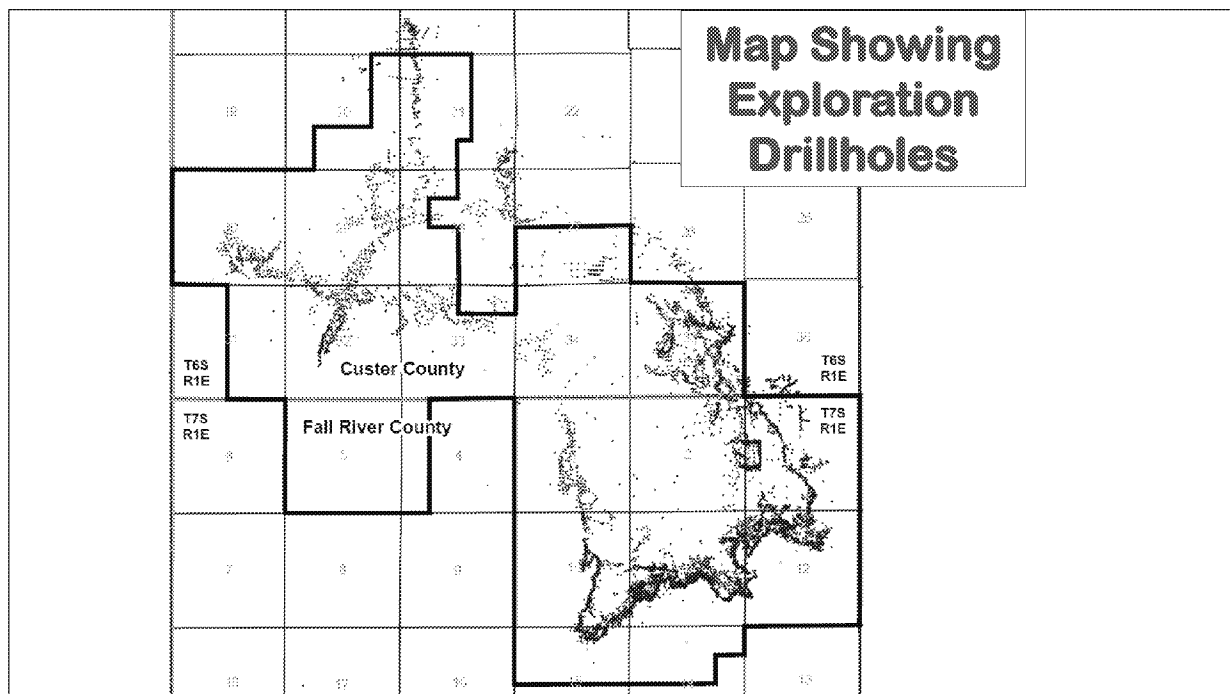
Excursion Monitoring

If an "expanding" excursion plume is detected, then the Class III draft area permit requires the permittee to install downgradient monitoring wells to determine if the excursion has crossed the aquifer exemption boundary.

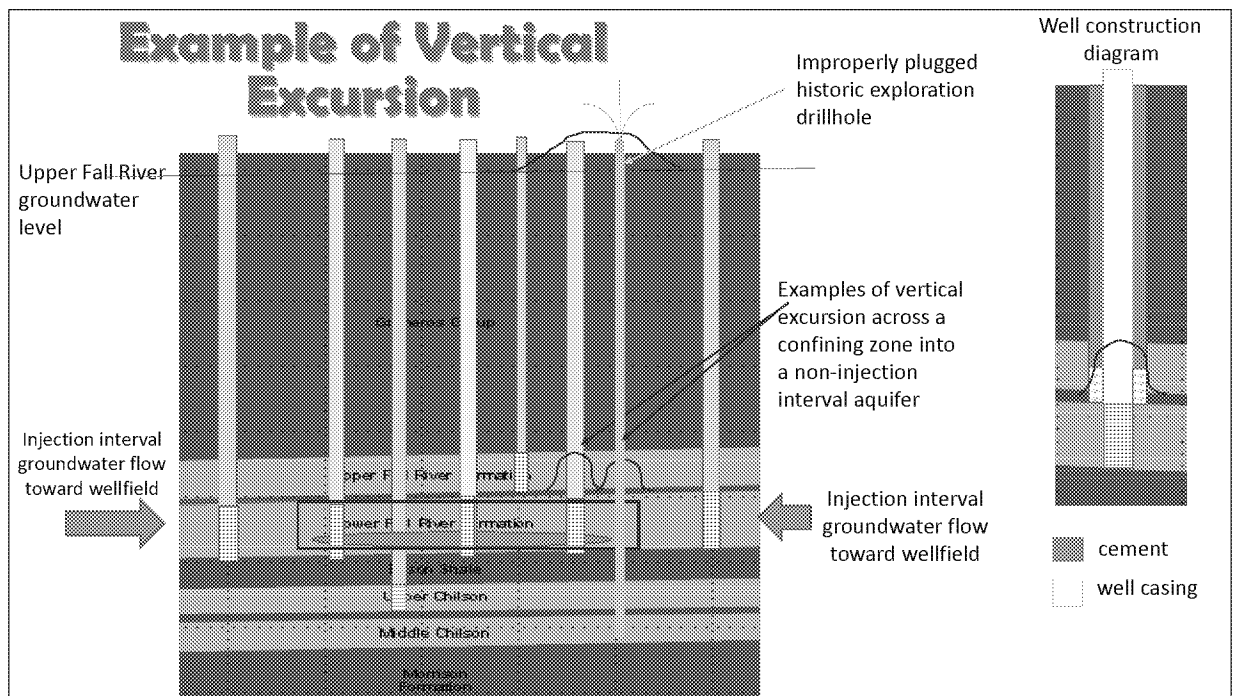
- additional monitoring wells down-gradient of the excursion plume leading edge where groundwater has not been impacted by excursion indicators

If ISR contaminants cross the aquifer exemption boundary into the USDW, that is a violation of the Class III permit and the permittee would be required to conduct aquifer remediation of the USDW.





5932 drillholes 109 Powertech drilled

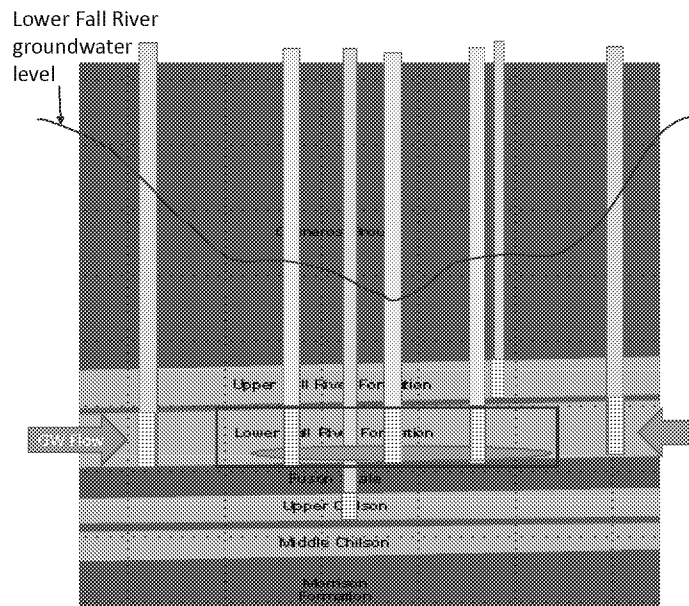


Other Regulatory Agencies at the Dewey-Burdock Site

- The Nuclear Regulatory Commission issued a License for the entire site.
- The South Dakota Department of Environment and Natural Resources has proposed issuance of a Large Mine Permit for the entire site.
- The BLM approved a Plan of Operations for portions of the site on BLM land.
- The South Dakota Department of Environment and Natural Resources has proposed issuance of a groundwater discharge permit for the land application of treated ISR waste fluids.

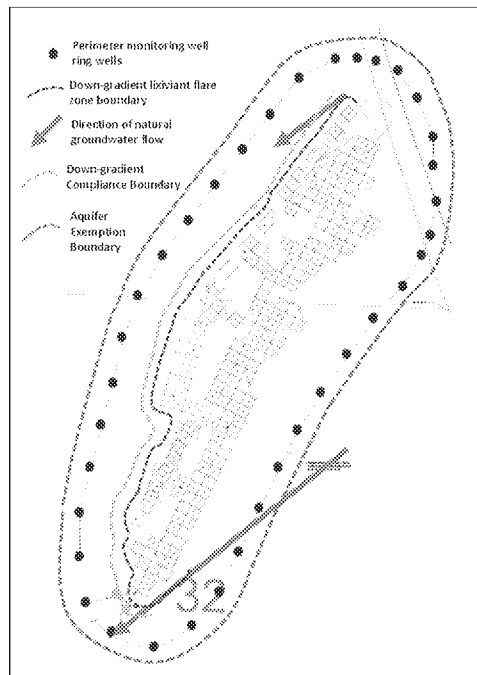
The Life of a Wellfield

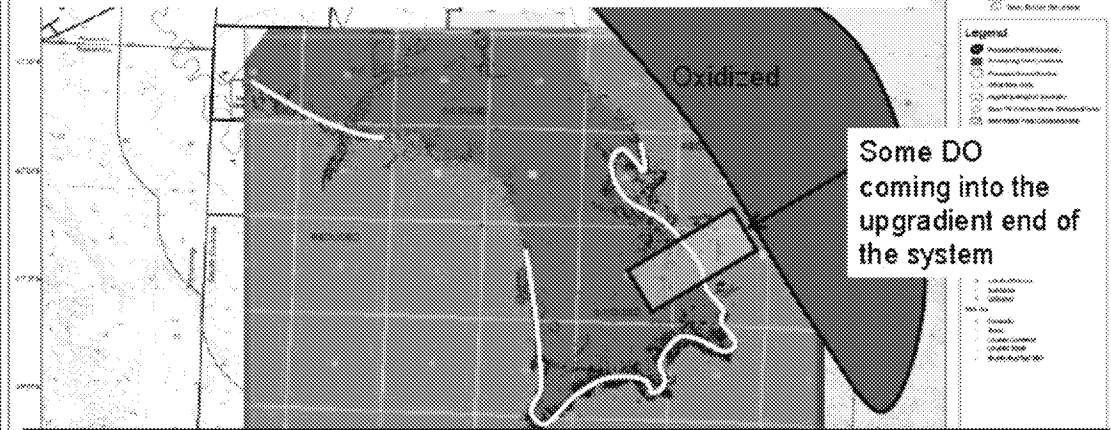
1. Uranium extraction in a wellfield takes about 2 years to complete.
2. Then NRC-regulated groundwater restoration begins.
3. Groundwater restoration continues until the groundwater is cleaned-up to pre-ISR or NRC-approved concentrations.
4. The NRC determines that groundwater restoration is complete.
5. The natural groundwater flow gradient restores itself.
6. After that the EPA Class III permit requires the Permittee to begin post-restoration groundwater monitoring to show that ISR contaminants do not cross the aquifer exemption boundary.



Post-restoration Monitoring

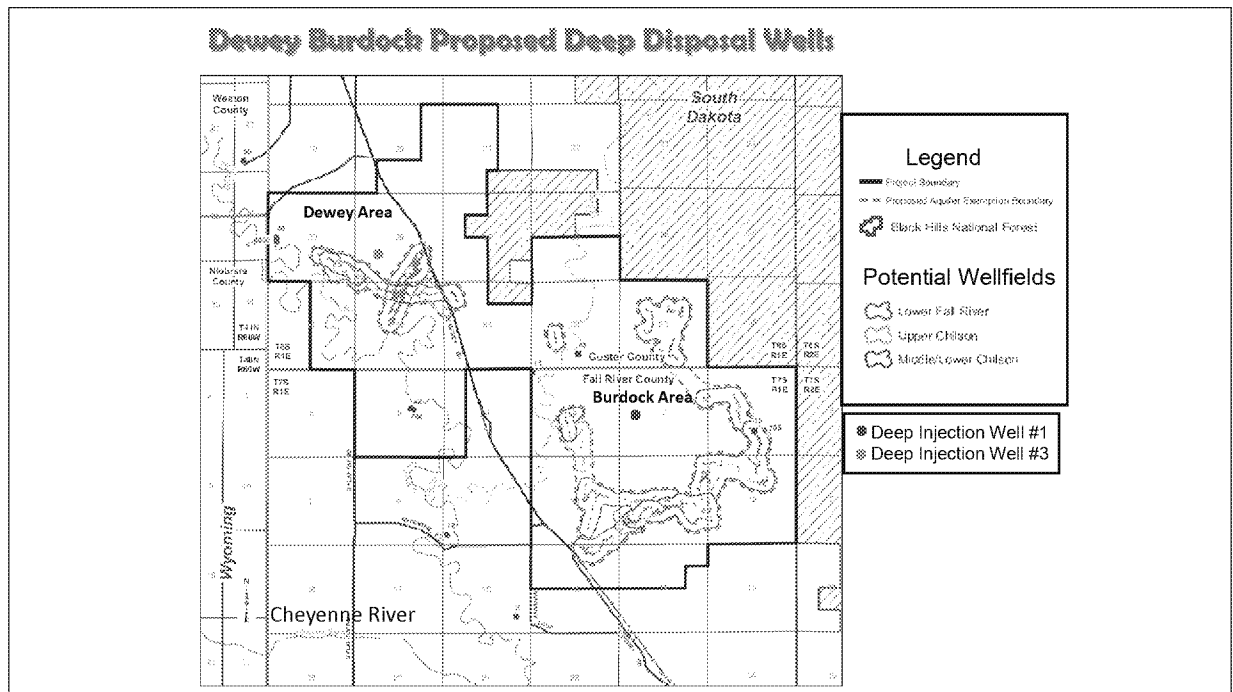
1. Post-restoration monitoring plan includes establishing a down-gradient compliance boundary.
2. Groundwater baseline constituent concentrations are used as the permit limits for determining that no ISR contaminants cross the aquifer exemption boundary.
3. The Permittee must demonstrate that no ISR contaminates cross the down-gradient compliance boundary.
4. Drill core from downgradient monitoring wells and laboratory column testing.
5. If ISR contaminants are detected at the down-gradient compliance boundary, the Permittee must establish a new boundary and perform remediation.
6. It is a permit violation if ISR contaminants cross the aquifer exemption boundary and groundwater remediation is required.



[illegible]

555-05

- ☐ a. 000000000000
- ☐ b. 00000000
- ☐ c. 000000000
- ☐ d. 0000000000



AE Boundary 120 feet outside of wellfield monitoring ring.

Point out:

SD WY Border

Custer and Fall River Counties

Dewey Area & Burdock Area

4 proposed wellfields in Dewey Area & 10 proposed wellfields in the Burdock Area.

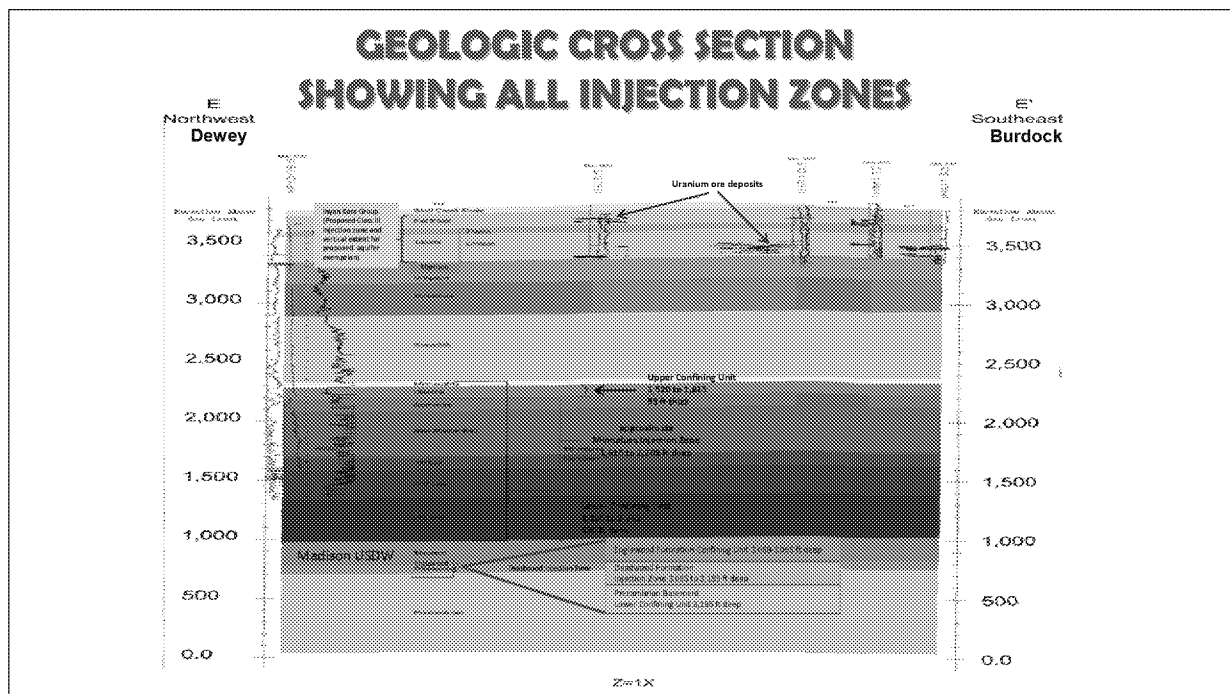
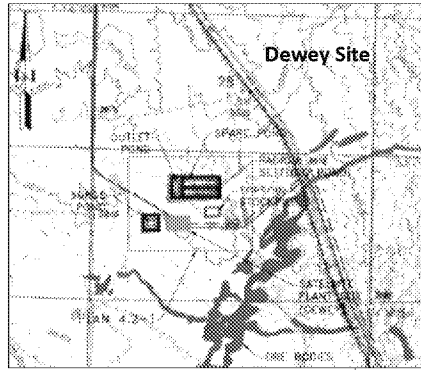


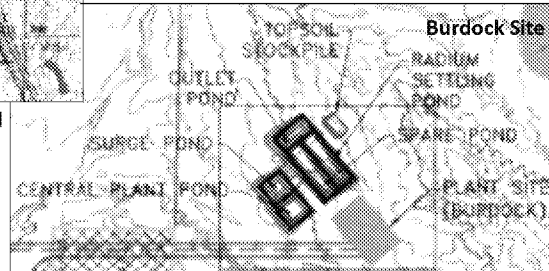
Figure 4. Stratigraphic Column at the Dewey Burdock Site Showing Proposed Injection Zones.
Enclosure to invitation letter

Treatment and Storage Pond: for Deep Well Injectate



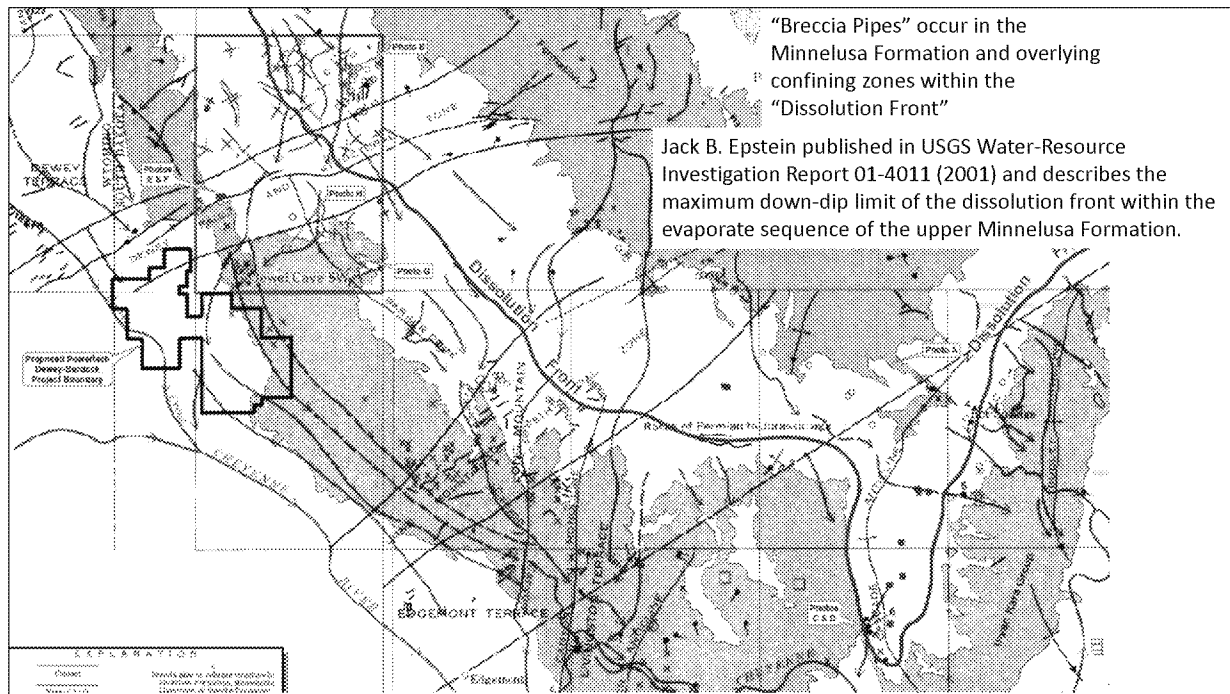
Waste fluids from the uranium recovery process will be treated in the radium settling ponds. After radium removal, the treated water will be stored in the outlet ponds and surge ponds. There will also be a spare radium treatment pond for backup. After treatment, the water will flow to the deep injection wells.

The Burdock Area central plant pond will store brine from the reverse osmosis treatment process used during groundwater restoration before the brine is treated in the radium settling ponds.

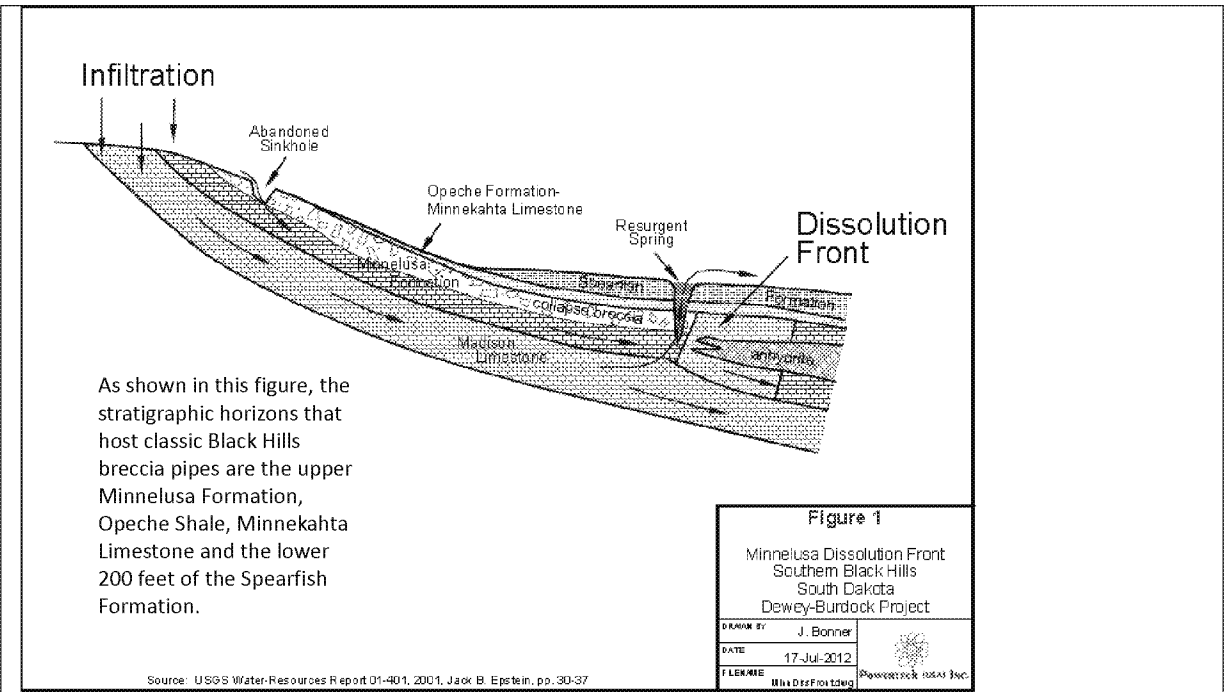


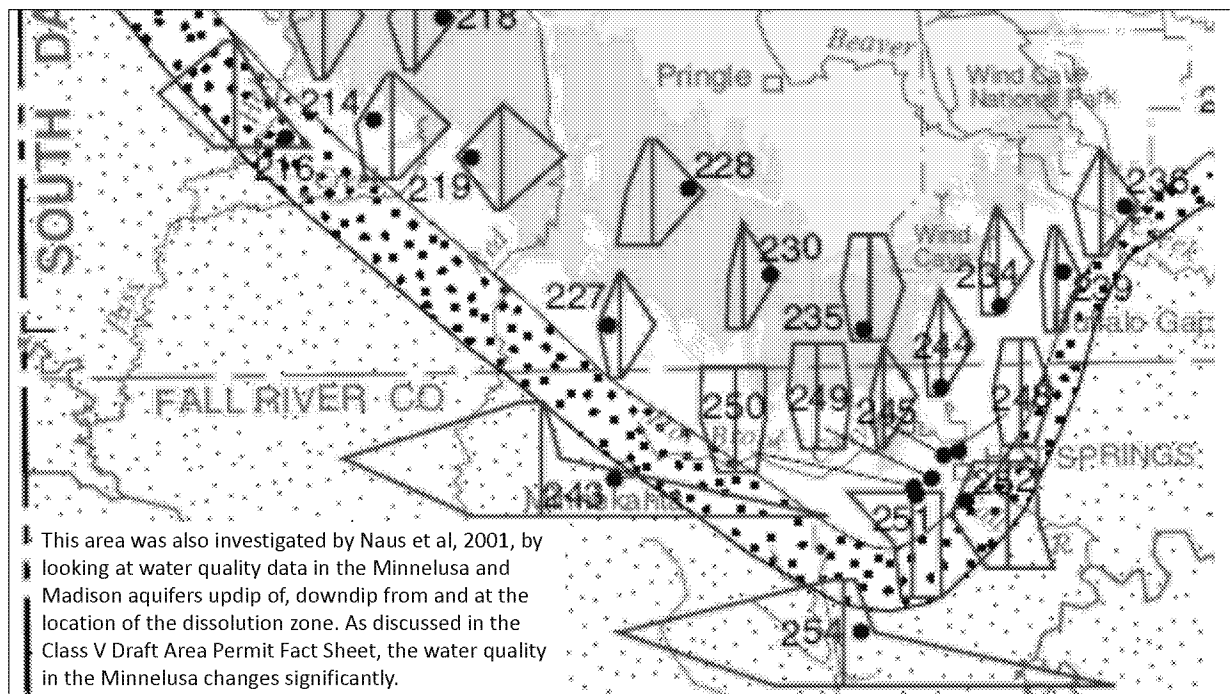
Class V Draft Area Permit Requirements

- Testing of the Minnelusa aquifer to confirm it is not a USDW. (The EPA will not authorize injection into a USDW.)
- Class I (the most protective) well construction standards.
- Extensive characterization of hydrogeology before the EPA will issue authorization to inject.
- Continuous monitoring of the fluid between the injection tubing and well casing for early detection of any injection tubing leaks.
- Treatment of the injectate to meet radioactive waste standards set in the NRC regulations (treatment using barium chloride to precipitate radium from the waste fluids in settling ponds).
- Treatment to meet hazardous waste standards (arsenic, barium, cadmium, lead, mercury, selenium and silver).

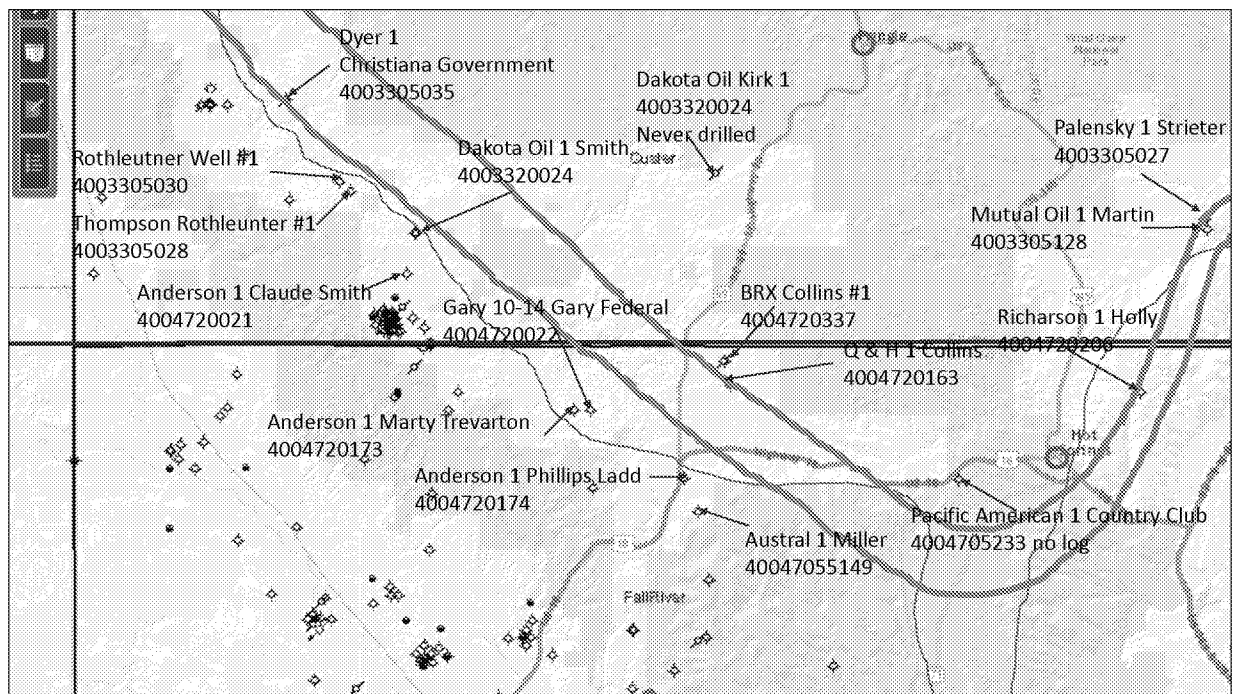


From USGS Prof Paper 763 Plate





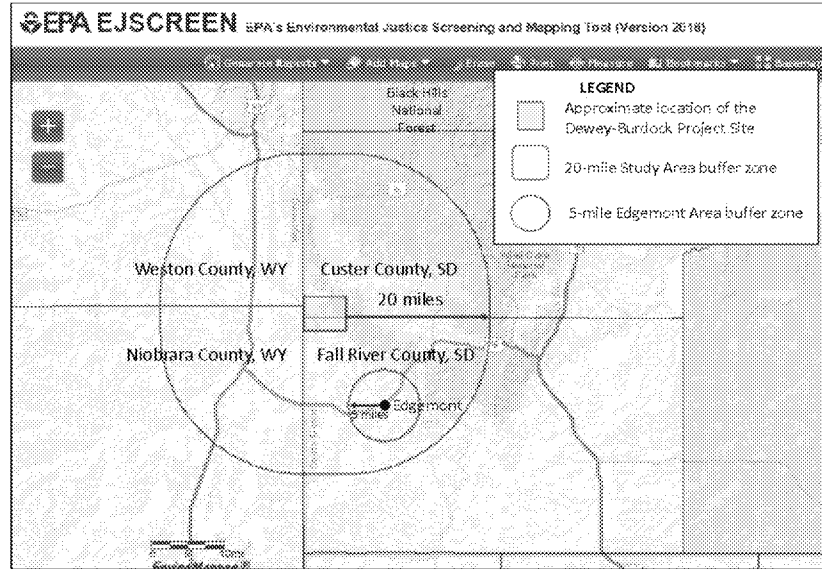
From Naus et al 2001 wri 01-4129
Figure 11 p. 24 of pdf



The Dewey-Burdoch UIC Administrative Record

- The Region 8 UIC Program issued two draft area permits on March 6, 2017.
 - One draft permit is a Class III Area Permit for injection wells for the in-situ recovery (ISR) of uranium in Inyan Kara aquifers;
 - The second draft permit is a UIC Class V Area Permit for deep injection wells that will be used to dispose of ISR process waste fluids into the Minnelusa Formation after treatment to meet radioactive waste and hazardous waste standards.
- The EPA also proposed an aquifer exemption approval in connection with the Class III Area Permit to exempt the uranium-bearing portions of the Inyan Kara Group aquifers.
- The EPA also released for public review and comment:
 - a draft Environmental Justice Analysis,
 - a draft Cumulative Effects Analysis, and
 - a draft document explaining process and considerations for Tribal Consultation.
- The public comment period ran from March 6 through June 19, 2017.

Environmental Justice Analysis



Cumulative Effects Analysis

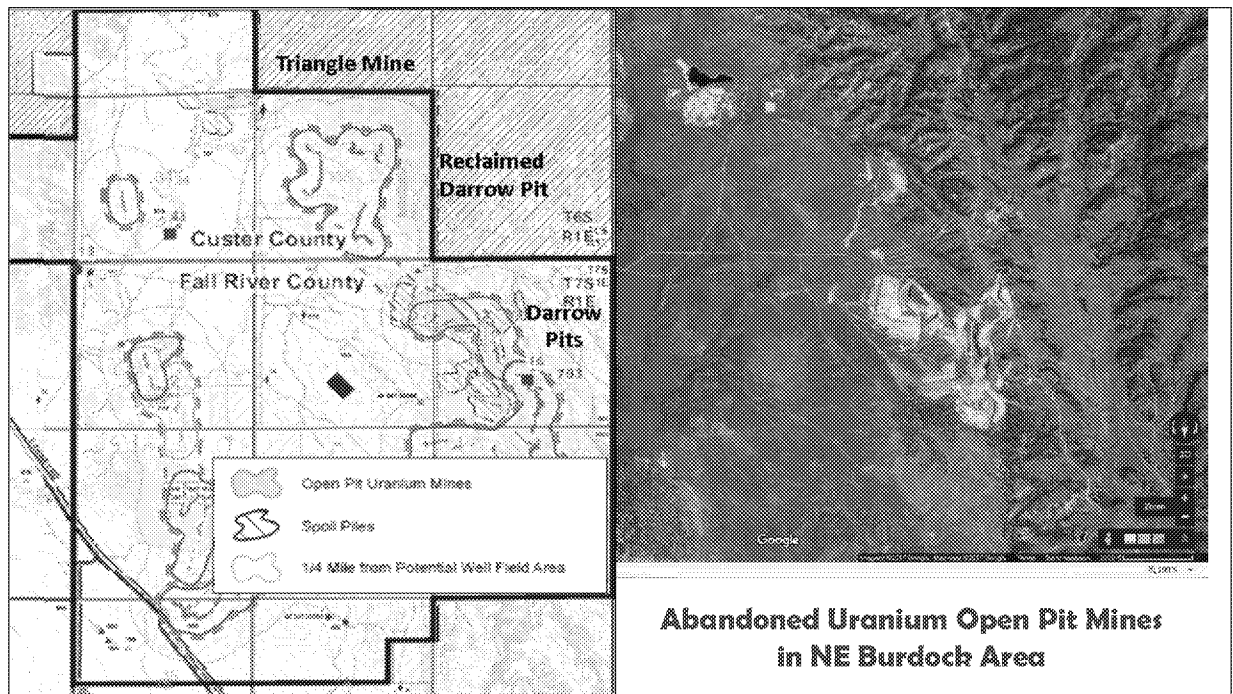
Areas where the EPA Evaluated Impacts Potentially Resulting from the
Drilling and Operation of Injection Wells Authorized under UIC Area Permit

§144.33 Area permits.

(c) The area permit may authorize the permittee to construct and operate, convert, or plug and abandon wells within the permit area provided:

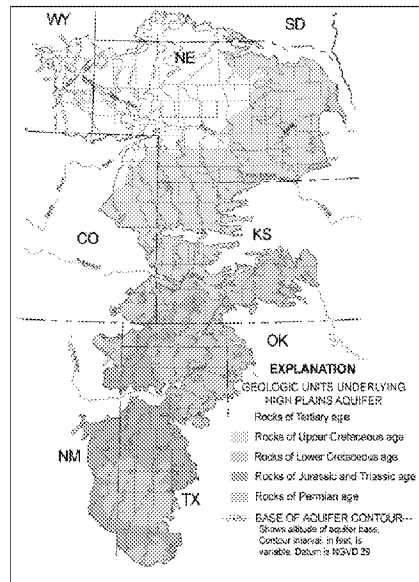
(3) The cumulative effects of drilling and operation of additional injection wells are considered by the Director during evaluation of the area permit application and are acceptable to the Director.

Impact Areas Investigated
Impacts to USDWs (water quality and quantity)
Impacts to surface water and wetlands
Impacts from spills and leaks
Impacts to land use
Impacts to soils
Impacts to geology
Potential radiological impacts and effluent control systems
Impacts to Air Quality
Climate change impacts
Transportation impacts
Impacts from Potential Accidents
Impacts to Ecological Resources
Impacts from Waste Management

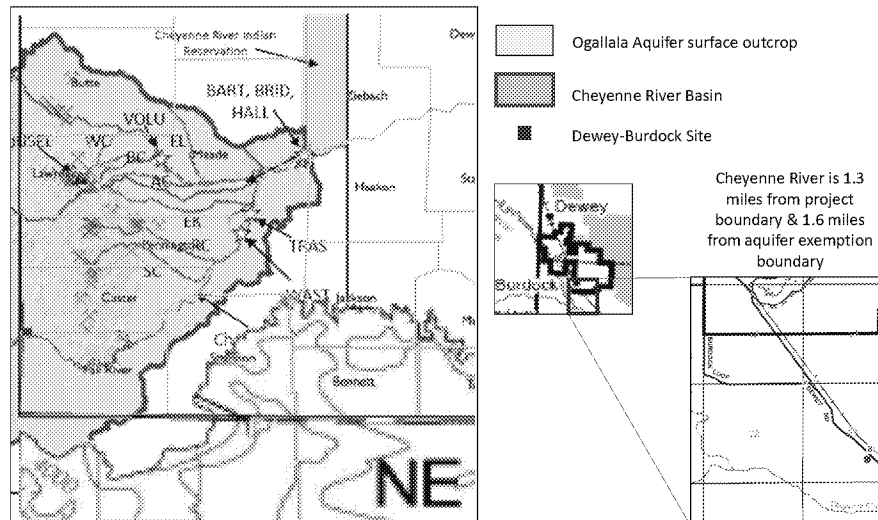


Check logs in cross-sections through WF 6, 7, 8 to see if the open pits are in the Upper or Lower Fall River

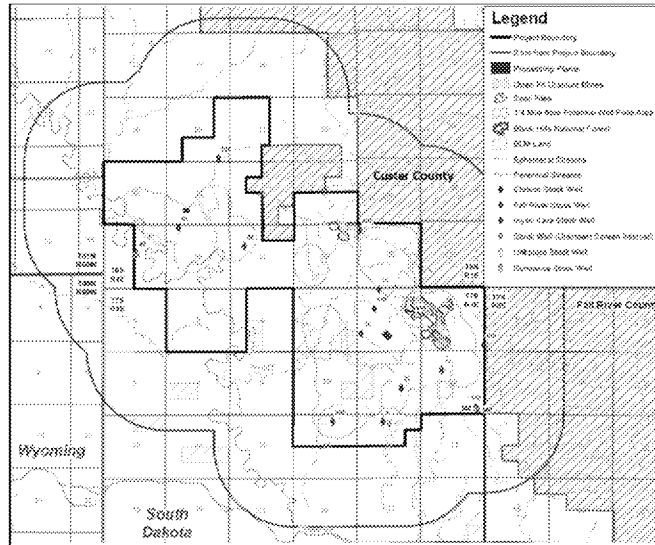
Extent of the Ogallala Aquifer



The Extent of the Ogallala Aquifer & the Cheyenne River Basin



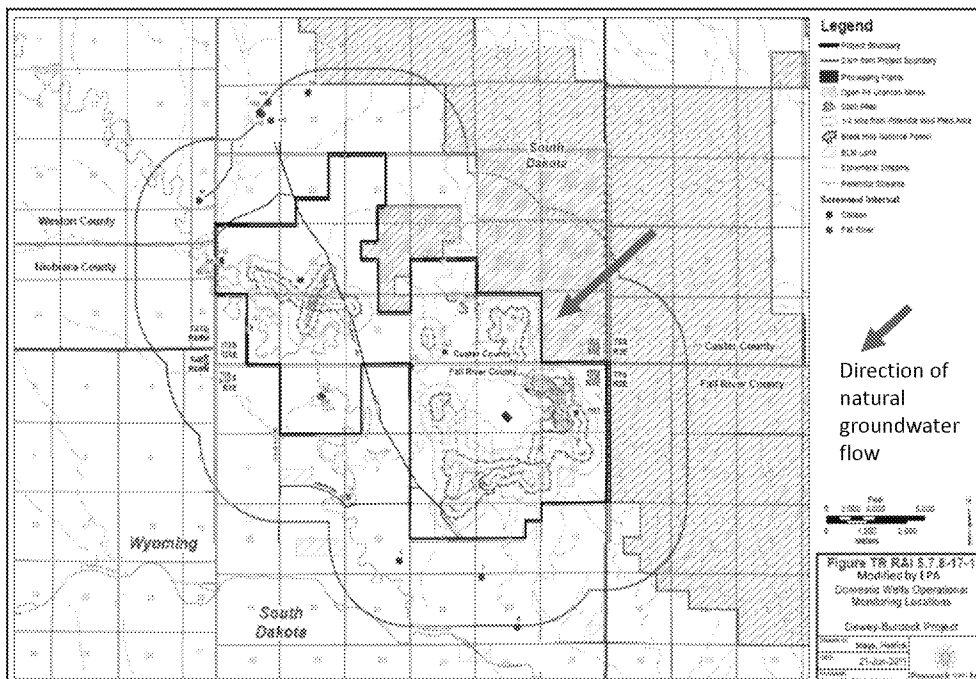
Operational Groundwater Monitoring



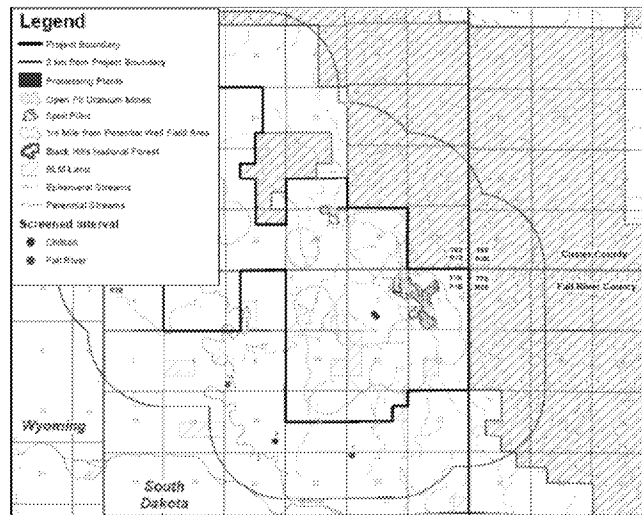
Stock Watering Wells

Private Drinking Water Wells

Nineteen Private Drinking Water Wells within the Dewey-Burdock Project Area of Review.



Operational Groundwater Monitoring

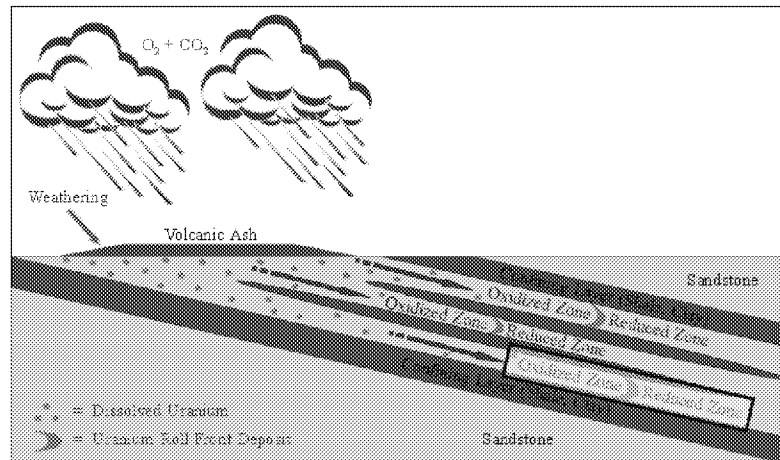


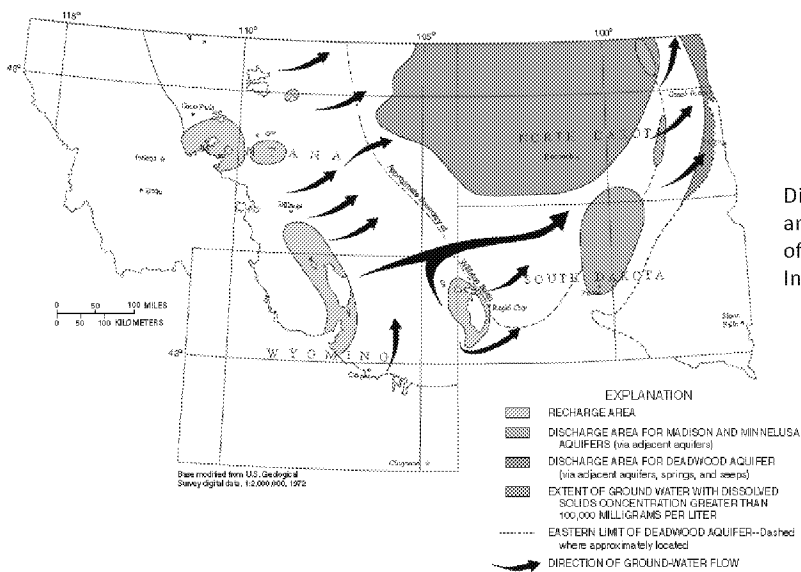
Three Domestic Wells: Hydro IDs 2, 7 and 18
Quarterly sampling; analyzed for baseline constituents

Baseline Water Quality Parameter List

Test Analyte/Parameter	
Physical Properties	Total Metals
pH	Aluminum, Al
Total Dissolved Solids (TDS)	Antimony, Sb
Specific Conductance ²	Arsenic, As
Common Elements and Ions	Barium, Ba
Total alkalinity (as Ca CO ₃)	Beryllium, Be
Bicarbonate Alkalinity (as Ca CO ₃)	Boron, B
Calcium	Cadmium, Cd
Carbonate Alkalinity (as Ca CO ₃)	Chromium, Cr
Chloride, Cl	Copper, Cu
Magnesium, Mg	Fluoride, F
Nitrate, NO ₃ (as Nitrogen)	Iron, Fe
Potassium, K	Lead, Pb
Silica, Si	Manganese, Mn
Sodium, Na	Mercury, Hg
Sulfate, SO ₄	Molybdenum, Mo
Radiological Parameters	Nickel, Ni
Gross Alpha	Selenium, Se
Gross Beta	Silver, Ag
Gross Gamma	Strontium, Sr
Lead 210	Thallium, Tl
Polonium 210	Thorium, Th
Radium, Ra 226	Uranium, U
Thorium 230	Vanadium, V
	Zinc, Zn

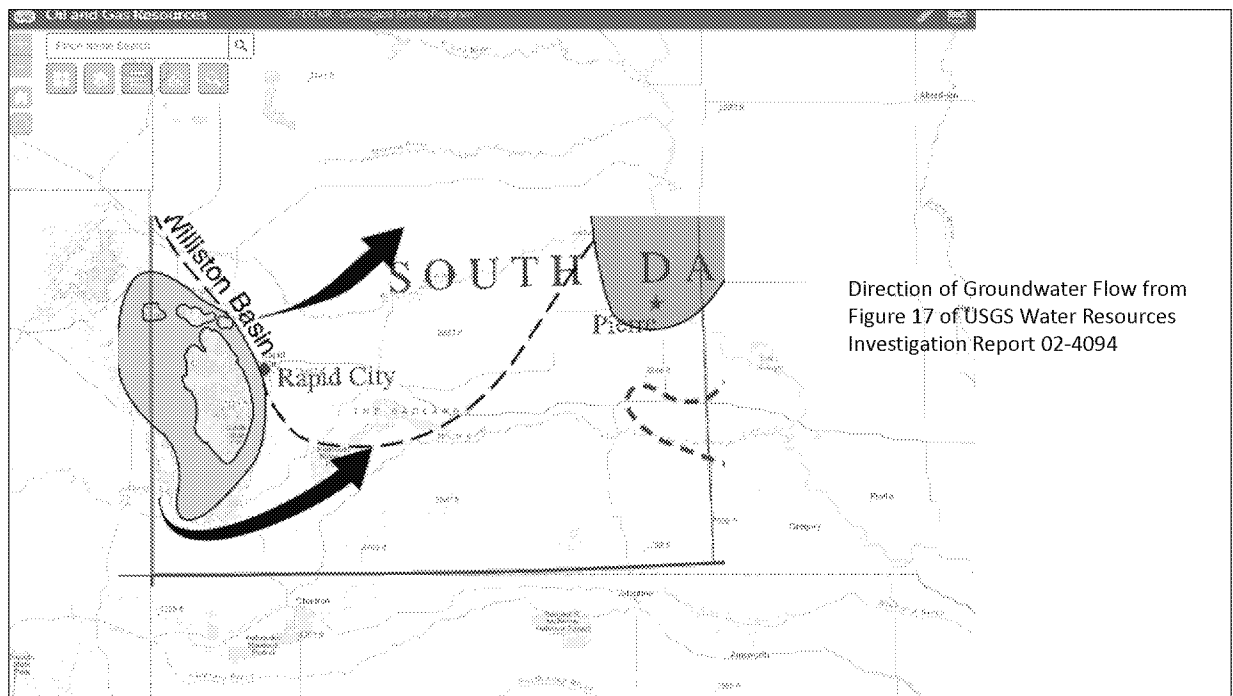
Roll-Front Formation





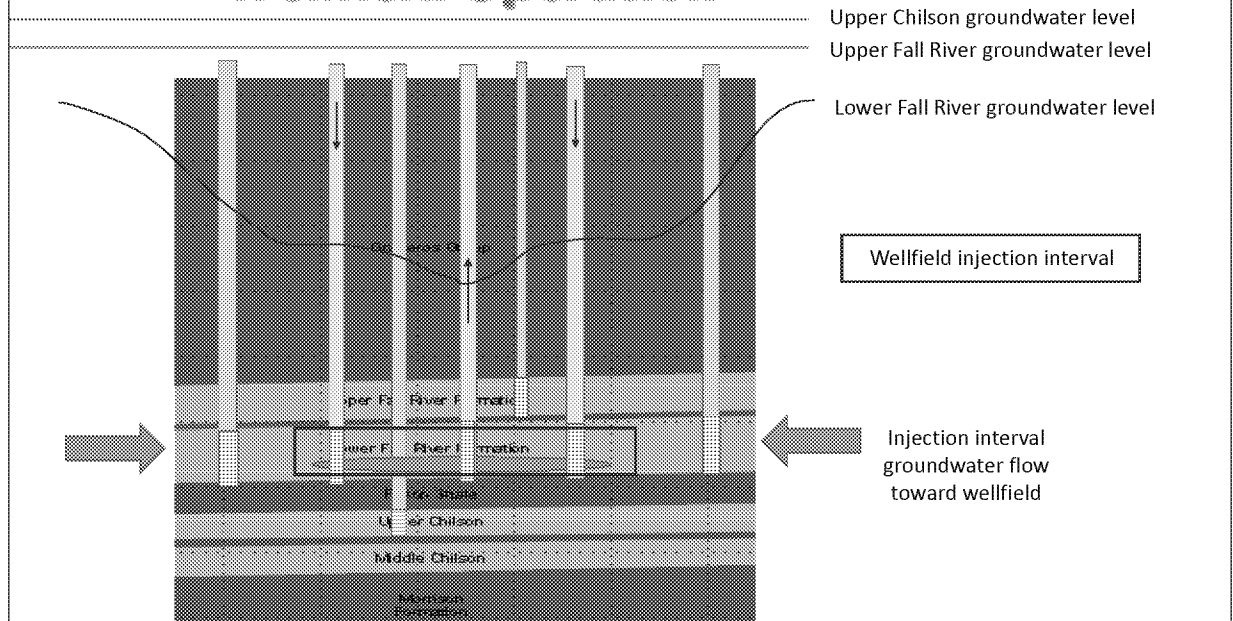
Direction of Groundwater Flow around the Black Hills from Figure 17 of USGS Water Resources Investigation Report 02-4094

Figure 17. General direction of ground-water flow in regional aquifer system within Paleozoic aquifer units (modified from Downey and Dinwiddie, 1968; Whitehead, 1996).



Direction of Groundwater Flow from
Figure 17 of USGS Water Resources
Investigation Report 02-4094

Wellfield Operation



§ 146.10 Plugging and abandoning Class I, II, III, IV, and V wells.

(4) The plugging and abandonment plan required in 40 CFR 144.51(o) and 144.52(a)(6) shall, in the case of a Class III project which underlies or is in an aquifer which has been exempted under §146.04, also demonstrate adequate protection of USDWs. The Director shall prescribe aquifer cleanup and monitoring where he deems it necessary and feasible to insure adequate protection of USDWs.

Tribal Consultation Efforts to Date

- Mailed request for consultation to 38 tribes in Regions 5, 6, 7 and 8.
- Eight tribes responded and requested consultation meetings.
- We held consultation meetings with seven of the eight tribes before the draft permits were issued.
- Four tribes have requested consultation meetings now that the draft permits have been issued.
- One important issue is a survey of traditional cultural properties at the site.
- A second important issue is identifying potential changes tribes would like to see in the NRC Programmatic Agreement.